

Risk of Premenopausal Breast Cancer and Patterns of Established Breast Cancer Risk Factors Among Teachers and Nurses

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Background *Contrasting results have been published regarding the risk of breast cancer among teachers and nurses. Confounding by reproductive factors may explain the increased risk observed among women in these occupations as information on those factors were not available in most studies.*

Methods *We examined the risk of premenopausal breast cancer among teachers and nurses using occupational histories in a case-control study where information on established risk factors was available.*

Results *Having ever held a teaching job was not related to breast cancer (OR = 0.74, 95% CI = 0.44–1.28) and women who worked for 10 years or less in this occupation had a non-significant deficit of risk (OR = 0.52, 95% CI = 0.27–1.02). No elevation in risk was found in association with having ever been a nurse (OR = 0.85, 95% CI = 0.45–1.61) or with duration of nursing. Although direct comparison of established risk factors among teachers and nurses and other women in the study showed some evidence of differential distribution, especially when comparing teachers to other women, adjustment for reproductive variables and other breast cancer risk factors did not change the results of this study.*

Conclusion *These findings suggest that teachers and nurses are not at an increased risk of breast cancer. This study also suggests that established risk factors for premenopausal breast cancer may not explain the elevation of risk found in other studies of teachers and nurses. However, this conclusion is limited by the fact that in the present study teachers and nurses had lower than expected breast cancer risk with or without adjustment for established risk factors. Limitations of this study such as low response rates and limited statistical power should be considered in the interpretation of these findings.* Am. J. Ind. Med. 35:137–141, 1999. Published 1999 Wiley-Liss, Inc.[†]

KEY WORDS: *teachers; nurses; breast cancer; case-control; occupation; women*

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INTRODUCTION

Several investigations suggest that teachers and nurses may experience elevated rates for breast cancer, as noted in a review of occupational risk factors for breast cancer by Goldberg and Labrèche [1996]. However, the results of more recent case-control studies do not support a positive association between these occupations the risk of breast cancer [Coogan et al., 1996; Habel et al., 1995]. A number of the positive studies were based on registry data where it was

impossible to control for confounders such as lifestyle and reproductive factors. To address this issue, we examined the risk of premenopausal breast cancer among nurses and teachers using lifetime occupational histories obtained through interviews with participants in a case-control study of risk factors for premenopausal breast cancer.

METHODS

Methods of this study have been described elsewhere [Freudenheim et al., 1996]. Briefly, women who were 40 years of age or older and premenopausal were eligible to be included in the study. Women were considered to be premenopausal if they were still menstruating, or if they were not menstruating because of hysterectomy or other medical intervention, if they had at least one ovary and were under age 50. Cases were incident, primary, pathologically confirmed premenopausal breast cancer cases identified from all major hospitals in Erie and Niagara counties in New York State between 1986 and 1991. Controls were selected randomly from the New York State Department of Motor Vehicles lists and were frequency matched to cases on age and county of residence. A total of 301 (66%) eligible cases and 316 (62%) eligible controls participated in the study. Participants signed an informed written consent granting an interview, and cases also gave permission to review their medical records.

Personal interviews were conducted using a standardized questionnaire to obtain information regarding occupational histories and other suspected risk factors for breast cancer. For each job held, participants reported job title, duties, calendar years employed, full- or part-time status, and the employer's name, address, and a description of what the company manufactured or service it provided. Jobs were coded according to the United States Bureau of Census codes [U. S. Department of Commerce, 1982].

Women were classified as having ever been a teacher if they had held at least one full- or part-time job as a pre-kindergarten, kindergarten, elementary, secondary, special education, or post-secondary teacher (codes 113–159). Similarly, women who worked in at least one job as a registered or licensed practical nurse (codes 095 and 207) were classified as having ever been a nurse. Both registered and licensed practical nurses were included because job exposures were likely to be similar. Women who were never employed as teachers or nurses served as the referent group in all analyses. Only 3% of women were never employed; these women were included in the referent group. Women who were missing an occupational title and did not have the occupation under investigation listed in their occupational history were excluded from all analyses (1 control in all analyses) involving that occupation. The duration of employment in a specific occupation was calculated as the number of years worked in all jobs in that occupation. Women who

were missing data on the number of years worked for any job in the occupation under investigation were considered to be missing total number of years employed in that occupation and were excluded from the analysis of the duration of employment in that occupation (1 case and 1 control were missing data on years employed as a teacher). The cut-points for the duration of employment variable were determined according to the distribution of years of employment among controls. Latency was defined as the number of years between the first year of employment in the occupation under investigation and the date of diagnosis for cases, or for controls, the date of entry into the study.

Established breast cancer risk factors presumed to be related to occupation were compared between the referent group and both teachers and nurses. In this population, age at menarche, age at first birth, nulliparity, family history of breast cancer, and history of benign breast disease were associated with increased risk [Freudenheim et al., 1996]. Student's *t*-tests were used to compare the means of exposed and non-exposed groups for continuous variables and Pearson's chi square was used for the comparison of the distribution of categorical variables. Unconditional logistic regression was used to estimate crude and adjusted odds ratios. Ninety-five percent confidence intervals were calculated using the beta coefficients and their standard errors [Breslow and Day, 1980]. In the adjusted model for each analysis, the occupational variable was entered followed by variables for established or suspected risk factors including age, years of education, Quetelet's index and age at menarche as continuous variables, age at first live birth (14–19, 20–21, 22–24, 25–36, never), history of benign breast disease (yes, no) and family history of breast cancer in a first degree relative (yes, no) as categorical variables. The number of months of lactation was not kept in the model since this variable was strongly related to age at first live birth ($P < .01$) and the addition of this variable did not change any of the results.

RESULTS

Presented in Table I are crude and adjusted odds ratios for the risk of breast cancer among teachers and nurses. Teachers had a slightly lower risk of premenopausal breast cancer compared to the referent, but confidence intervals included unity. The adjusted odds ratio (OR = 0.74, 95% CI = 0.49–1.10) did not differ from the crude (OR = 0.75, 95% CI = 0.44–1.28). Working ten years or less as a teacher was related to a 50% reduction in risk compared to women who had never held a teaching or nursing job, but confidence intervals included unity (95% CI = 0.27–1.02). We observed no relationship between employment in the teaching profession for the duration of 11 years or greater and premenopausal breast cancer.

TABLE I. Premenopausal Breast Cancer Risk Among Teachers and Nurses, Western New York State, 1986–1991*

	Cases/controls (n)	Crude OR (95% CI)	Adjusted OR (95% CI) ^a
Never	229/223	1.0	1.0
Ever teacher ^b	53/70	0.74 (0.49–1.10)	0.75 (0.44–1.28)
Duration ^c			
1–10 years	20/38	0.52 (0.29–0.91)	0.52 (0.27–1.02)
>10 years	32/31	1.02 (0.60–1.71)	1.07 (0.55–2.09)
Ever nurse ^b	24/28	0.83 (0.47–1.48)	0.85 (0.45–1.61)
Duration ^b			
1–10 years	10/14	0.70 (0.30–1.61)	0.78 (0.32–1.90)
>10 years	14/14	1.00 (0.46–2.10)	0.92 (0.41–2.09)

*OR, odds ratios; 95% CI, 95% confidence intervals.

^aAdjusted for age at menarche, benign breast disease, family history of breast cancer in a first-degree relative, age, education, age at first birth, and Quetelet index.

^bOne control missing data for one or more job(s) was excluded.

^cOne control missing data for one or more job(s), 1 case and 1 control missing data on the number of years worked as a teacher were excluded.

There was a non-significant deficit in risk among nurses (OR = 0.85, 95% CI = 0.45–1.61). When the exposed group was restricted to registered nurses, the odds ratios decreased slightly, but confidence intervals still included unity (OR = 0.72, 95% CI = 0.52–1.23). Duration of employment was not related to risk for all nurses, or for registered nurses. We also did not find any effect of latency (<20 years, 20+ years) (data not shown). In all analyses, adjusted odds ratios did not differ from crude.

The distribution of non-occupational factors among premenopausal participants are shown in Tables II and III for teachers, nurses, and for the women who never were employed in these occupations. A significantly greater proportion of teachers had a later age at first live birth or were nulliparous, more likely to have lactated for at least 2 weeks, and were less likely to have ever smoked cigarettes compared to the participants who were never employed as a teacher or a nurse. Teachers had a higher average number of years of education compared to the referent and a greater number of births. Similar to teachers, nurses were more likely to have lactated for 2 weeks or longer compared to participants in the referent group, and had a significantly higher average of years of education and greater number of births compared to the referent.

DISCUSSION

These data do not support the hypothesis that a history of employment as a nurse or a teacher is a risk factor for premenopausal breast cancer. In fact, we found that women who were employed as a teacher for up to 10 years may have a deficit of risk when compared to women who never

TABLE II. Characteristics of Premenopausal Cases and Controls by History of Employment in Teaching Occupations, Western New York State, 1986–1991

	Never teacher or nurse ^a		Ever teacher ^a			Ever nurse ^b		
	n	%	n	%	P*	n	%	P*
Family history								
Yes	43	9.5	12	9.8		8	15.4	
No	409	90.3	11	90.2	.94	44	84.6	.18
History of benign breast disease								
Yes	174	38.7	53	43.1		19	36.5	
No	276	61.3	70	56.9	.37	33	63.5	.77
Ever smoke								
Yes	277	61.3	51	41.5		28	53.8	
No	175	38.7	72	58.5	<.01	24	46.2	.30
Months of lactation								
0	313	69.2	70	56.9		24	46.2	
≥0.5	139	30.8	53	43.1	.01	28	53.8	<.01
Age at first birth								
14–19	105	23.2	8	6.5		13	25.0	
20–21	88	19.5	12	9.8		17	32.7	
22–24	96	21.2	25	20.3		8	15.4	
25–39	103	22.8	48	39.0		5	9.6	
Nulliparous	60	13.3	30	24.4	<.01	9	17.3	.10

^a64 controls and 48 cases who were employed as nurses, but never as teachers were excluded.

*Test of difference for Pearson's chi square.

^b22 controls and 19 cases who had been employed as nurses, but never as teachers were excluded.

worked as a teacher or a nurse. Our results are in contrast to registry-based studies that compared usual occupation with breast cancer risk and found higher risks among teachers [Bulbulyan et al., 1992; Morton, 1995; King et al., 1994] and nurses [Bulbulyan et al., 1992; Morton, 1995; Roman et al., 1985; Cantor et al., 1993; Sankila et al., 1990]. They are also in contrast to the results of a cohort study that showed elevations of risk among nurses [Gunnarsdottir and Rafns-son, 1995]. However, a more recent report of the results of a case-control study nested in this cohort showed that risk of breast cancer depended on nursing specialty [Gunnarsdottir et al., 1997]. Elevations were seen among nurses who worked in geriatric, psychiatric, and pediatric wards, operating rooms, intensive care, and among those handling cytostatics, while all nurses combined, and nurses who worked in primary care, medical, anesthesia, and surgery wards had a deficit of risk. A number of positive studies showed approximately a 10% increase in risk among nurses [Rubin et al., 1993; Peipins et al., 1997] and teachers [Williams et al., 1977]. No significant increase in risk was seen among

TABLE III. Mean Values of Selected Characteristics for Premenopausal Women by History of Employment as a Teacher or Nurse, Western New York State, 1986–1991

	Never teacher or nurse		Ever teacher			Ever nurse		
	Mean	± SD	Mean	± SD	P*	Mean	± SD	P*
Age	46.0	3.6	45.8	3.6	.99	46.0	4.4	.59
Years of education	12.9	2.2	17.1	2.0	<.01	15.7	1.8	<.01
Quetelet index (kg/m ²)	25.5	5.5	25.6	5.6	.82	25.7	4.8	.86
Age at menarche ^a	12.7	1.7	12.7	1.7	.20	12.4	1.2	.77
Months of menstruation ^b	372.7	48.2	373.3	52.4	.83	371.1	48.7	.91
Age at first live birth ^c	19.5	8.7	19.1	11.2	.99	19.5	9.8	.74
Parity	2.4	1.5	1.9	1.5	.40	2.6	2.6	<.01

*Student's *t*-test for difference between means of each occupation compared to the referent.

^aSix participants in the referent with missing data were excluded.

^bOne participant in the referent with missing data was excluded.

^cNulliparous women were excluded.

teachers and nurses in two case-control studies in which occupational data were obtained from participants [Habel et al., 1995; Coogan et al., 1996]. Based on participants' three major jobs, Habel et al. [1995] found small nonsignificant increases in breast cancer risk among teachers and nurses. Results from a case-control study by Coogan et al. [1996] indicated that teachers and nurses were not at increased risk of breast cancer.

It has been hypothesized that established breast cancer risk factors such as late age at first birth are related to professional employment and may confound results of occupational studies. Two registry-based studies showed that excluding homemakers diminished breast cancer mortality ratios detected among nurses and teachers, suggesting that perhaps the elevated mortality associated with these occupations was due in part to confounding by reproductive variables [Threlfall et al., 1985; King et al., 1994]. In both studies, when homemakers were included in the analyses, the proportionate mortality ratios (PMR) for nurses were significantly elevated. However, when homemakers were omitted, no excess breast cancer mortality was noted. Among teachers, PMRs for breast cancer decreased when homemakers were excluded, but were still elevated. These results suggested that confounding by reproductive factors may account for some of the observed elevations in breast cancer seen among nurses and teachers in other studies.

Conversely, results of case-control studies of nurses, teachers, and other professionals did not change after adjustment for breast cancer risk factors [Habel et al., 1995; Coogan et al., 1997]. In the present study, adjustment for reproductive and other established breast cancer risk factors had little effect on our results; however, neither teachers nor nurses demonstrated an excess risk before adjustment. Teachers were, however, older at age at first birth, and both teachers and nurses had on average more years of education

compared to other participants. If these factors confounded results, one would have expected odds ratios to have decreased after adjustment. These findings suggest that when studying occupational risk factors for premenopausal breast cancer, established risk factors such as age at first birth may not confound results, at least for some occupations. The possibility that reproductive factors confound results for other occupations should not be dismissed. Conclusions regarding the effect of confounding in studies of breast cancer among teachers and nurses differ between case-control and registry-based studies. In the registry studies, omitting homemakers changes the referent group and may adjust for reproductive or other unknown factors. In the case-control studies, direct statistical adjustment for these factors was made. This difference may account for the contrasting results.

Other factors may contribute to the inconsistency of findings regarding risks of breast cancer among teachers and nurses. The difference in assessing risk related to occupation from occupational histories reported by participants versus usual occupation listed on death certificates could be a factor. First, inaccuracies of the usual occupation recorded on death certificates could introduce bias to any studies using these data. When comparing occupational data from death certificates to occupational histories, Schade et al. [1988] found that among women, the match rates for individual usual occupations were all under 60%. Second, participants who had been employed in several occupations throughout their lives, as were most participants in our study, could be misclassified as non-exposed when analyses are based on one job only. Women who had held one job in the occupation under investigation, but whose usual occupation was different, would still be considered exposed in analyses examining risk related to having a history of ever working in that occupation. These same women would be

classified as non-exposed in analyses examining risk associated with usual occupation. This could dilute relative risks by excluding individuals with short-term employment in the occupations of interest. Analyses by duration, however, should address this problem. Additionally, women who worked part of their life, but were also housewives, might be classified as homemakers on their death certificates and considered non-exposed or omitted from death certificate studies. In some previous studies of breast cancer risk among teachers and nurses [Rubin et al., 1993; Threlfall et al., 1985] where death certificate data was used for the usual occupation, 45 to 90% of the participants had homemaker listed as their usual occupation.

The low response rates in both cases and controls must be considered in the interpretation of these data. If factors related to employment as a teacher or a nurse were related to participation in this study, especially if this relationship differed between cases and controls, selection bias could affect the results. If controls who had been employed as teachers or nurses were more likely to participate in our study because they were more health conscious, the odds ratios in our results were underestimated. Participation did not seem to be related to health consciousness characterized by dietary habits, as indicated by a study of a sample of the non-respondents [Freudenheim et al., 1996]. Furthermore, if participation among controls were related to a greater number of years of education or higher socioeconomic status, odds ratios might also be underestimated. However, there was a considerable number of controls who were employed in managerial and professional specialties who were never employed as nurses or teachers included in the control referent group (58 or 26%) and in the case referent group (39 or 17%). Among cases, the primary reason for nonparticipation was refusal by physicians to grant us permission to contact their patients. If these refusals were related to disease status, with physicians refusing to allow us to contact patients with more advanced disease, then our results might not generalize to those cases. Along with lacking the statistical power to conduct detailed analyses, we were also unable to examine risk for nurses in individual specialties because we did not have this information in the occupational histories. The grouping together of all nurses regardless of specialty may have masked elevations of risk among nurses in certain specialties. As discussed earlier, Gunnarsdottir et al. [1997] found that nurses in several specialties had an increase in the risk of breast cancer, but nurses overall did not.

This is one of the first epidemiologic breast cancer studies examining risk related to occupations using lifetime occupational histories while also adjusting for other breast cancer risk factors. These additional data allowed us to examine risk related to ever having been employed as a teacher or a nurse and duration of employment in these occupations independent of other important risk factors. Additional studies of nurses that include information regard-

ing nursing specialty and exposures are necessary to investigate further whether nurses are at increased risk for premenopausal breast cancer.

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